Problem 8.3.1 Murder Mystery: Time of Death

Introduction

The police are investigating a mysterious death at a local hotel and would like the assistance of your team. To begin the investigation, read the memo to investigators:

READ MEMO----

One of the methods used to determine the time of death is algor mortis, or cooling of the body. After death, a body will lose body heat until it reaches the temperature of the surrounding environment. Many factors influence the rate of heat loss including clothing, victim size, activity, and environmental factors such as temperature and humidity.

In this activity you will investigate relative cooling rates and estimate time of death based on temperature data for a murder victim.

Adapted with permission from "Cooling Rates" and "Hot Air, Cold Body" by Vernier.

Equipment

- Laboratory Journal
- Pencil
- Murder Mystery Case Report
- Computer
- 2 Go!Temp Temperature Probes
- 2 one-hole stoppers
- Large plastic bottle
- Small plastic bottle
- Hot tap water

Procedure

Part 1: Cooling Rates

To determine how body size affects cooling rate, you will complete an experiment that models cooling of a body.

With your group discuss which you think cools faster, a large body or a small body. Record your prediction and answer conclusion question 1.

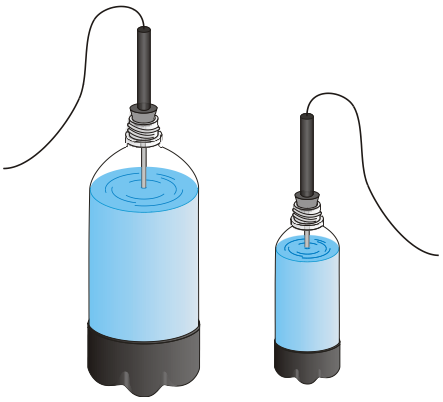
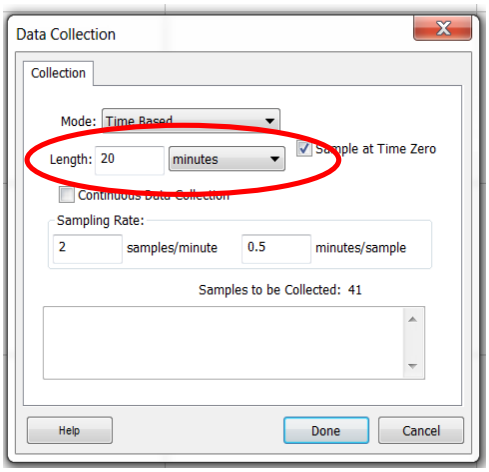


Figure 1

1. Slip a one-hole stopper that fits the large bottle onto Probe 1. Slip a one-hole stopper that fits the small bottle onto Probe 2 as shown in Figure 1.
2. Connect the temperature probes to the computer and start the Logger Lite program.
3. Click Experiment and choose Data Collection. A new box will appear.
4. Change Length to 20 minutes as shown below. Click Done.



5. Fill the large plastic bottle and the small plastic bottle with hot tap water. **CAUTION:** Be careful not to burn yourself.
6. Place Probe 1 into the large bottle and Probe 2 into the small bottle.
7. Watch the temperature readings on the screen. When they both stop rising, click Collect to begin data collection.
8. When data collection is complete (data has been collected for 20 minutes), click the Statistics button, , then click OK to display a Statistics box for each probe.

9. Record the minimum temperature and the maximum temperature for each bottle in the conclusion section. Determine the temperature change for each bottle and record.
10. Print copies of the graph as directed by your teacher.
11. Answer conclusion questions 2-5.

Part 2: Time of Death

Refer to the Case Report detailing the murder of the hotel elevator operator. Note the temperature of the victim and the time below, then use the formula provided to determine the approximate time of death.

12. Body temperature: _____

13. Time temperature recorded: _____

14. Elevator temperature: _____

The Glaister equation is one formula used to approximate the postmortem interval, or time since death. Note: This equation uses degrees Fahrenheit. Convert body temperature from Celsius (^{o}C) to Fahrenheit (^{o}F) using the following formula:
$^{o}F = {}^{o}C \times 9/5 + 32$

Glaister Equation:

$$\frac{98.4 - \text{measured rectal temperature}}{1.5} = \text{approximate hours since death}$$

15. Use the Glaister equation to estimate the time of death for the murder victim.

Approximate time of death: _____

16. Answer remaining conclusion questions.

Conclusion

1. What do you think cools faster, a large body or a small body? Explain.

2. Record data below:

	Large bottle (Probe 1)	Small bottle (Probe 2)
Maximum temperature	°C	°C
Minimum temperature	°C	°C
Temperature change	°C	°C

3. Was there any difference in the cooling rates of the bottles? Try to explain the difference.

4. Do your results support your prediction about the cooling of large and small bodies?

5. Algor mortis, or postmortem cooling of the body, varies with body size. Based on your results, would a large person or a small person's body cool faster after death?

6. The murder victim was found in an elevator that was 20 degrees Celsius, or 68 degrees Fahrenheit. How would your estimated time of death change if the body had been found outside on a cold winter day when the temperature was near freezing?